Available online at www.sciencedirect.com

ScienceDirect

Procedia Environmental Sciences 29 (2015) 97

Procedia Environmental Sciences

Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

How potato plants take the heat?

Sophia Sonnewald, Jessica van Harsselaar, Kirsten Ott, Julia Lorenz, Uwe Sonnewald

Friedrich-Alexander-University Erlangen-Nuremberg, Staudtstrasse 5, 91058 Erlangen, Germany

Abstract

Potato is the third most important food crop in the world after rice and wheat. Because of its widely distributed cultivation and high yields, it is considered a critical species in terms of food security in face of a growing world population. However, potato is particularly vulnerable to high temperature during various stages of its life cycle. Elevated temperatures strongly suppress tuberization, negatively affect storage and shelf life of tubers and reduce fitness of seed potatoes. Breeding new heat-stress tolerant cultivars is therefore an urgent need for sustainable increases in potato production. To achieve this goal an integrated approach combining physiology, biochemistry and molecular genetics is followed to analyze the impact of elevated temperatures on source-sink relations of potato plants, potato tuber development, starch accumulation and tuber quality and tuber dormancy. First results indicate that heat effects source-sink relations by altered expression of the tuber inducing signal FT, by stimulating shade-avoidance responses of the shoot and by decreasing sink-strength of developing tubers. Sink strength of growing potato tubers is mainly regulated by the activity of sucrose synthase. Measuring sucrose synthase expression and activity of heat grown potato tubers revealed a significant down-regulation of the enzyme which is consistent with reduced tuber growth. Interestingly, genetic variation in the activity of sucrose synthase exists, potentially enabling selection of potato varieties with heat-tolerant sucrose synthase isoforms. Although FT seems to play a major role in regulating tuberization, sink-derived and additional source signals are likely to be involved in orchestrating the heat-induced shift in assimilate allocation. This assumption is based on experiments in which soil and air temperatures of pot grown potato plants were independently controlled in growth chambers and transcript as well as sugar and enzyme profiles were recorded. Results of this analysis and their implication to improve heat tolerance of potato plants will be discussed.

Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Keywords: Potato; high temperature; sink-strength; assimilate allocation

References

Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

doi:10.1016/j.proenv.2015.07.178